NATIONAL PARK SERVICE
CHANNEL ISLANDS NATIONAL PARK

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MARINE DEBRIS MONITORING PROGRAM
1992 ANNUAL REPORT

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ABSTRACT

Results are presented from three quarterly surveys conducted during 1991-1992 (year four of a five year program) at six study beaches on Santa Rosa and San Miguel Islands within Channel Islands National Park (CHIS). A total of 15,116 items was recorded, 95% consisting of plastic. As in previous years, foam fragments were again the single most abundant item. Comprising 40% of the total, this was the first time foam fragments were less than half. Glass bottles were the most abundant non-plastic category. Quantities of plastic debris were greatest on the winter (March/April) surveys.

The 10 most abundant plastics in rank order were foam fragments, hard plastic fragments, bottles < 1 gallon, caps and lids, straws, bags < 1 m^2, balloons, rope < 1 m, food containers, and toys. Plastic objects that could be ingested by marine wildlife were less abundant than in past years because of the decline in foam fragments. Debris considered to be an entanglement hazard to wildlife has risen 32% over the last two years.

Much of the debris on the islands originated on the mainland, presumably washed down rivers and storm drains and deposited during the winter storms. Debris from commercial and recreational fishing, and litter from boaters (both pleasure and commercial) are other major sources of marine

debris on the beaches of the Channel Islands.

INTRODUCTION

Marine debris has become an issue of national concern in recent years. Plastic debris is of greatest concern because of its persistence in the environment and the hazards it poses to wildlife that may ingest it or become entangled in it. Marine debris also presents health and safety hazards and diminishes the aesthetic value of our beaches.

In order to establish a scientific data base about the abundance, composition, and accumulation rates of human-generated marine debris found on continental United States beaches, the National Park Marine Debris Monitoring Program was initiated in 1989. This five-year research effort, jointly funded by the National Park Service (NPS) and the National Marine Fisheries Service (NMFS), is monitoring the marine debris accumulation in eight National Parks located along the Pacific, Gulf, and Atlantic Coasts. Cole et al. (1990), Manski et al. (1991), and Cole et al. (1992) describe the results from the first three years of this national monitoring program.

Channel Islands National Park (CHIS) is one of the 10 parks in this program. Richards and Dugan (1991), Richards (1991), Richards (1992) describe the results from CHIS during the first three years of monitoring. This report summarizes the results from year 4 of monitoring marine debris at CHIS.

STUDY AREA

Channel Islands National Park consists of five islands and surrounding marine ecosystems off the southern California coast. The park boundary includes five of the eight California Channel Islands and the submerged lands and waters within 1.8 km (1 nm) of each island. The islands range in size from 260 ha Santa Barbara Island to 25,100 ha Santa Cruz. The total area of the park (100,000 ha) is divided nearly equally between submerged lands and islands. The park is surrounded by the Channel Islands National Marine Sanctuary and is an International Man in the Biosphere Reserve. The islands harbor the only remaining relatively pristine coastline in southern California and are recognized for the rich abundance of wildlife that concentrates around the islands to breed.

The two islands in this study, Santa Rosa (21,450 ha) and San Miguel (4,047 ha) have a mix of sandy beaches and rocky shoreline. Santa Rosa and San Miguel Islands are the two western-most islands in the chain. Santa Barbara and Anacapa Islands are small volcanic islands with few sandy beaches. Santa Cruz Island has long stretches of sandy beach, but was privately owned an innaccessable when this project started.

Prevailing winds throughout most of the year are from the northwest, hitting San Miguel and western Santa Rosa Island with full force from the open sea. Major storms often bring large southerly swells which impact the south facing beaches.

Northeasterly "Santa Ana" winds occasionally occur in the fall and winter, generally creating calm conditions at Santa Rosa and San Miguel Islands.

The Santa Barbara Channel which separates the islands from the mainland coast is a major shipping route for vessels to and from the ports of San Pedro, Long Beach, and Los Angeles. The southbound shipping lane comes within a few km of the northern islands.

The Santa Maria Basin, which lies just north of Point Conception, and the Santa Barbara Channel have extensive oil and gas development. Offshore oil rigs are present throughout the Channel and Basin. Several storage and refinery facilities are located in the area and are regularly serviced by tankers.

Substantial recreational and commercial fishing fleets operate out of Ventura and Santa Barbara harbors, primarily working within the park boundary. Various trawlers, gillnetters, and purse seine boats ply the channel and island waters for rockfish, shark, squid, halibut, and other ground fish. Commercial divers collect sea urchins and abalone near shore around the islands. As many as 65 fishing vessels have been observed around the west end of Santa Rosa Island on one day (Pers. obs., Dec. 1991).

There is extensive military activity in the area originating from the two Navy bases in Oxnard and Port

Hueneme, and the facilities on San Clemente and San Nicolas Islands. Within the park boundary, a small Navy facility exists on Santa Cruz Island and air operations are conducted around Santa Rosa and San Miguel Islands.

STUDY BEACHES

Marine debris was monitored at five 1-km and one 600-m beaches (Figure 1). Public use of all six beaches was very low. Visitation to these beaches was primarily by NPS island personnel. Though chosen to avoid disturbing as little wildlife as possible, all of the beaches are important to wildlife. Each of the beaches are utilized at times by foraging shorebirds and resting harbor seals and elephant seals. Western snowy plovers, an threatened species, use the beaches for nesting in the spring and summer.

1. Simonton Cove: This beach faces directly into the prevailing northwest wind, with no protection from any points of land. The long, wide beach is backed by low dunes and a steep bluff. Average width of the beach was approximately 40 m. The flat beach consists of fine sand.

2. Cuyler Harbor: This sandy beach faces north and is somewhat protected by the island to the west. High dunes back the beach at both ends and a rocky cliff with a small jutting

reef break up the beach in the middle. Most of the beach is less than 20 m wide. Cuyler Harbor is the primary anchorage on San Miguel Island with an average of two to three boats (maximum, approximately 20-30) anchoring there at night during most months. This is the only beach with much public access; however, visitation is still low.

3. Sandy Point: This beach faces northwest, though the winds may be tempered somewhat by Point Conception, approximately 60 km to the north. This beach undergoes severe erosion at times leaving several small rocky points along the 1 km transect. The width varies from 10 to 40 m at low tide. Large amounts of kelp wrack often pile up on the beach after storms. The narrow beach is backed by a low cliff.

4. Arlington Canyon: This flat, sandy beach is 600 m long with a northern exposure. The beach is backed by dunes and a small lagoon fed by a perennial stream near the west end of the beach. Except at the lagoon where it is generally wider, the width is only about 10 m. Kelp wrack occasionally piles up very deep along the waters edge after storms. This beach was included in the surveys because it was the most accessible beach with this exposure.

5. Cluster Point: The only survey beach on the south side of

the island, this beach faces southwest. The sand beach is generally flat and fairly broad (20-30 m wide). Low vegetated dunes back the western half of the beach forming a narrow toe along cliffs. The eastern half of the beach is backed by a low dune field and forms a small hook at the rocky point on the eastern margin.

6. Skunk Point: The east end of the survey transect is over 50 m wide as the point curves around to the south. The sand beach is very flat and often overwashed by high tides. Occasionally a shallow lagoon forms behind the berm. Low dunes behind the beach gradually climb a tall bluff. The northern exposure faces Beechers Bay, which is a popular anchorage and is the main access to the island and ranch operation.

METHODS

Beaches were surveyed in November/December 1991, March/April 1992, and September 1992. Intense storms throughout the month of March delayed the winter surveys into April. Rain from the March storms caused erosion on the roads, delaying surveys of some beaches. Spring surveys (June) were not conducted to avoid disturbing nesting snowy plovers.

Two to eight people conducted the surveys. The survey

area for each beach included the intertidal zone between the water's edge and the seaward limit of terrestrial vegetation or base of the foredune or cliff. All human-generated debris visible from a walking height was collected and recorded on data sheets (see Manski et al. 1991 for debris definitions). Debris was generally sorted and tallied off-site. All debris was either removed or marked and noted so not to be counted on future surveys. Tar on the beach was noted as present or absent.

Items less than one-half their original size were considered fragments. Netting with less than five complete meshes were also regarded as fragments. Plastic cones from hagfish traps were reported as fishing gear fragments, but were noted as a special category also. Items attached as a functional unit were not counted separately (e.g., a rope connected to a float was classified as a float). Items were classified to their use (e.g., plastic bottles with a line attached were classified as other floats).

Plastic items considered as wildlife entanglement hazards included: rope $\geq$1 m, trawl web, gillnets, closed straps, fishing line, six-pack yokes, rope loops, and gaskets/rings/bands. Plastic debris regarded as harmful to wildlife if ingested included bags, foam fragments, balloons, sheeting, and pellets. Measurements and other information on ropes, netting, and floats were recorded (see Manski et al.

1991 for data sheets).

In March 1992, new categories were accepted for the debris surveys to include items of interest to the Environmental Protection Agency (EPA). Most of the changes were minor. All oil containers were combined into one category (previously categories were quart and five-gallon containers). New categories that split out specific items were cotton swabs, condoms, crack vials, pipe-thread protectors, write protection rings, and hard hats. We also noted syringes (with sizes) and syringe parts.

Subsampling was performed on the winter (April) survey of Sandy Point. Debris was collected from three randomly chosen 100 m transects at 300, 600, and 800 m along the survey beach. Debris from other transects was not removed. Values were extrapolated from the three random transects to equal 1 km.

Quarterly data from the debris surveys were entered into a computerized data base for analysis and graphics production by Dr. Andrew Cole at Nova University.

RESULTS

A total of 15,116 items was recorded during 18 beach surveys in year 4. The total quantities of debris by season are presented in Table 1. Plastic constituted 95% of the total debris (Figure 2). Glass (mostly bottles), metal

(mostly cans) and paper made up the non-plastic portion of the samples. Wood was not counted and will not be considered in analysis. Glass bottles/jars was the 11th most abundant category overall. On all six beaches, plastics made up over 80% of the total debris with Cuyler Harbor having the highest percentage of non-plastic debris.

Miscellaneous plastic was the most common plastic debris category (51%), followed by packaging (33%), fishing (9%) and personal items (7%). The ranking of these four categories did change seasonally, most notably in the summer sample when packaging surpassed the miscellaneous category with over 40% of the total debris (Figure 3). There was also a slight rise in fishing gear in the winter survey. The miscellaneous category was dominated by foam and hard plastic fragments which were the two most abundant plastic items.

Collectively, the 10 most abundant plastic items (Figure 4) accounted for 82% of all the debris found. Foam and hard plastic fragments comprised 56% of the top ten items, which was a drop of 15% from last year's composition. Foam fragments (5,271 pieces) averaged 293 per km, accounting for 35% of the total debris items. This is a decline from 55% of the debris and 547 fragments per km in year 3. Sandy Point had the most foam fragments closely followed by Arlington Canyon Beach. The fall (December) survey of Sandy Point had the single greatest total of foam fragments at nearly 1700.

Hard plastic fragments, small bottles, caps and lids, straws, small bags, balloons, rope fragments, plastic food containers, and toys round out the top ten most abundant plastic items for year 4. Oil containers, tobacco accessories, and small plastic sheets are other items that made it into the top ten seasonally (Figure 5).

Ingestible debris was dominated by foam fragments (Table 2). Small plastic bags, balloons, and small plastic sheets were other ingestible items that were abundant. Seasonal abundances of ingestible items were generally highest in the winter surveys.

Entangling debris (Table 3) was present at a mean of 15.1 items per km, nearly a 20% increase over year 3 (32% over year 2). Rope was the most common item, though it was less abundant this year. Simonton Cove had the most rope by number (8/ km) and length (197 m total). Increases in the numbers of closed straps (2.1/ km up from 0.7/ km in year 3) and gaskets/rings (4.7/ km up from 2.1/ km in year 3) accounted for most of the overall increase in entangling items. There was no clear seasonal pattern for the overall entangling category. Rope was most abundant in the fall and summer, while straps and rings were most common in the winter survey. Most of the closed straps came from the Arlington Beach winter (March) survey. The closed straps generally encountered were strips cut from innertubes which are used as

spring closures on crab and lobster traps. Lobster season runs from October to March.

Two western gulls were found entangled in monofilament fishing line just out of the Cuyler Harbor transect area, one of which was hooked in the mouth. A lobster trap with a dead lobster was found at Cluster Point.

Only 10 plastic and two glass medical debris items were found accounting for much less than 1 percent of the total debris. Items found include insulin type syringes and prescription pill bottles. Glass vials accounted for the non-plastic medical debris.

Unusual debris items included three bottles with notes in them, full cans of beer, a German bottle of Budweiser beer, diving fins and masks, numerous plastic flower pots, a surfboard, jumper cables, a copy machine toner cartridge, a bowling pin, a sex toy, and a compressed styrofoam cup.

Identifiable items included the notes in bottles, a balloon from the Santa Barbara County Supervisor campaign, milk cartons produced in Asia and Australia, a military phosphorus container and part of a target missile. Oil industry items found were several hard hats, one pipe thread protector, and one write ring protector.

Tar or oil was found on all surveys. There are numerous natural oils seeps in the Santa Barbara Channel area and the beach tar is likely from natural sources.

Table 1. Total quantities of marine debris at Channel Islands National Park in Year 4. Totals are from all six beaches. Values from Arlington Canyon were extrapolated to 1 km, and the winter sample from Sandy Point was extrapolated from subsamples.

DEBRIS ITEM	TOTAL NUMBER OF DEBRIS ITEMS FOUND	MEAN NUMBER OF DEBRIS ITEMS PER KM
FISHING GEAR		
TOTAL	1095	60.8
Trawl Net	4	0.2
Monofilament Gillnet	3	0.2
Multifilament Gillnet	0	0
Rope >=1 m	98	5.4
Rope < 1 m	283	15.7
Mono Fishing Line	1	0.1
Rope Loops	18	1.0
Open Straps	64	3.5
Closed Straps	38	2.1
Trawl Float	4	0.2
Gillnet Float	27	1.5
Crustacean Float	99	5.5
Buoy Bag	7	0.4
Other Float	61	3.4
Oil Container	217	12.1
Fish Basket	0	0
Bait Containers	64	3.5
Lures	5	0.3
Chemical Ampules	0	0
Light Stick	16	0.9
Fragments	41	2.3
Miscellaneous	45	2.5
PERSONAL EFFECTS (PLASTIC)		
TOTAL	983	54.4
Hats/Helmets	22	1.2
Footwear	79	4.4
Gloves	8	0.4
Smoking Accessory	145	8.1
Toys	244	13.5
Balloons	305	16.9
Comb/Brush/Eyeglass	29	1.6
Tampon Applicators	27	1.5
Cotton Swabs	15	0.8
Condom	1	0.1
Syringe	2	0.1
Crack Vial	0	0

Miscellaneous	106	5.8

Table 1. (Continued)

DEBRIS ITEM	TOTAL NUMBER OF DEBRIS ITEMS FOUND	MEAN NUMBER OF DEBRIS ITEMS PER KM
PLASTIC PACKAGING		
TOTAL	4878	271
Bottles <= 1 Gal.	1357	75.4
Caps/Lids	1345	74.7
Bags < 1 m	614	34.1
Bags >= 1 m	4	0.2
Cups	46	2.5
Styrofoam Cups	30	1.7
Styrofoam Food Container	10	0.6
Container/Bowl/Utensil	256	14.2
Drinking Straws	1033	57.4
Pails/Buckets	23	1.3
Six-Pack Yokes	25	1.4
Beverage Crates	0	0
Bulk Liquid Container	14	0.8
Styrofoam Packaging	29	1.6
Miscellaneous	92	5.1
MISCELLANEOUS PLASTICS		
TOTAL	7458	414.1
Sheet < 1 m	207	11.5
Sheet >= 1 m	6	0.3
Shotgun Wads	57	3.2
Pipe/Tubing	45	2.5
Brushes/Brooms	15	0.8
Garbage Cans	3	0.2
Tires/Innertubes	9	0.5
Hard Fragments	1678	93.2
Foam Fragments	5271	292.8
Pellets	0	0
Gaskets/Rings	85	4.7
Miscellaneous	64	3.5
Medical	10	0.5
Pipe-thread protectors	1	0.1
Hardhats	5	0.2
Write protection rings	2	0.1

Table 1. (Continued)

DEBRIS ITEM	TOTAL NUMBER OF DEBRIS ITEMS FOUND	MEAN NUMBER OF DEBRIS ITEMS PER KM
NON PLASTICS		
TOTAL	702	38.9
Glass Bottles	229	12.7
Light Bulbs	54	3.0
Medical (glass)	2	0.1
Glass Pieces	9	0.5
Misc. (glass)	1	0.1
Paper	141	7.8
Bottle Caps	2	0.1
Propane Canisters	6	0.3
55-Gallon Drums	0	0
Beverage Cans	65	3.6
Other Cans	82	4.5
Wire/Cable	6	0.3
Crab/Fish Traps	5	0.3
Metal Pieces	63	3.5
Misc. (metal)	12	0.7
Cloth	25	1.4
Leather	0	0
GRAND TOTAL	15,116	839.2

Table 2. Types and quantities of ingestible plastic items per km at Channel Islands National Park, Year 4. Six 1-km beaches were sampled in Fall 1991, winter and summer 1992.

Debris item	Mean #/km (std. dev.)	Min-Max
Foam fragments	292.8 (429.3)	12-1695
Bags < 1 m^2	34.1 (34.6)	0-117
Balloons	16.9 (14.9)	0-47
Plastic sheet < 1 m^2	11.5 (14.9)	0-51
Plastic sheet ≥ 1 m^2	0.3 (0.7)	0-2
Bags ≥ 1 m^2	0.2 (0.5)	0-2

Table 3. Types and quantities of entangling plastic debris per km at Channel Islands National Park, Year 4. Six 1-km beaches were sampled in Fall 1991, winter and summer 1992.

Debris Item	Mean #/km (Std. Dev.)	Min-Max
Rope ≥ 1 m	5.4 (4.0)	0-13
Gaskets/rings	4.7 (5.1)	0-17
Six-pack yokes	1.4 (1.5)	0-4
Rope loops	1.0 (1.7)	0-7
Closed straps	2.1 (6.5)	0-28
Mono. fishing line	0.1 (0.2)	0-1
Trawl net	0.2 (0.4)	0-1
Mono. gill net	0.2 (0.7)	0-3

Multi. gill net	0	0

DISCUSSION

The results over the last three years indicate a downward trend in the amount of debris on the beaches. The average number of debris items per km in year 4 (839) was substantially less than year 3 (1013) and year 2 (1043). Plastics comprise the vast majority of debris on the beaches of San Miguel and Santa Rosa Islands. Foam fragments continue to outnumber all other debris items, though in this year 4 of the study, foam fragments comprised less than half of the total debris for the first time.

Foam fragments appear to originate form many sources. Styrofoam cups and food containers (galley waste) that breakup on the beaches are probably the largest single source. Packing material, foam "peanuts", and fragmented foam insulation also contribute to the foam fragment problem. Hard fragments also come from a variety of sources and generally result from plastics beginning to break down in the sun.

During March of 1992, southern California experienced torrential rains which caused many of the coastal streams to flood. Erosion was severe in areas on the islands and effects on debris deposition or removal from the beaches is unknown. It was apparent that much of the debris on the beaches originated from the mainland, as cane (arundo grass) from the mainland rivers (it does not grow on the islands) was abundant on the beaches. Other items, such as toys, have been abundant in the past and have been suspected of originating from the

mainland.

Despite the high amount of debris that originated from the mainland, there was relatively little evidence of sewage associated waste, and it could just as well have originated from offshore vessels. Cotton swabs and tampon applicators are considered indicators of sewage and both items were rarely encountered.

The commercial and recreational fishery around the Channel Islands was another source of debris worth mention. Nearly 10 percent of the debris was attributable directly to fishing. Rope and rope fragments were the most commonly encountered items. Floats were common and many had long pieces of rope attached which creates an entanglement hazard. Other items such as dive gear and metal traps (and many of the pieces) may also relate to the fishing industry. Some items considered galley waste (plastic bottles, bags, glass bottles, food containers) likely emanated from fishing or pleasure vessels at the islands. Oil containers (the 7th most abundant item in the winter survey) are also associated with the boating activities around the islands. Carelessness could contribute to accidental litter from blowing winds.

Overall, there was a decline in the amount of ingestible debris from years past because of the decline in the amount of foam fragments. Somewhat disturbing however, were the increases in all other categories of ingestible debris. The number of small plastic bags has doubled over the last two

years. Though sea turtles are rare around the Channel Islands, there are other animals such as molas and birds that may potentially ingest plastic, taking it for a food item. Sea urchins have been observed on many occasions feeding on plastic bags. The effects on the invertebrates are unknown.

Entangling debris items continued the trend of increasing each year. The increase this year came from closed straps and gaskets/rings; both more than doubling. Although rope was less numerous this year, the total length of rope pieces came to over 1,200 m, an increase of about 30% over last year. Considerably more rope was attached to buoys and therefore not counted. Nearly all the rope was poly line 8-20 mm in diameter. Many of the pieces were three meters or less in length.

This year, only 11 hagfish trap cones were found on survey beaches, a decline from 34 and 89 in the previous two years. The pieces found were generally just the black plastic cone used at the mouth of the trap. Five-gallon buckets were used as traps and occasionally the entire lid with the cone entrance was found. Presumably some buckets found in surveys could have been used as traps. This fishery is completely market driven with the hagfish being exported to South Korea for eelskin leather production. The hagfish fishery in southern California ended after only one year of explosive growth in 1990.

Weather conditions are likely to be a factor in the

distribution of debris. Major storms can potentially act as both sources and sinks of accumulated debris on the beaches. As there are relatively few visitors on the beaches of the Channel Islands, debris originating from the islands is most likely non-existent. Large storms, especially with heavy rains, wash a large amount of debris from urban streams and sewer drains into the coastal ocean. Currents carry the debris to the islands where it can accumulate on the beaches. High winds may blow more debris onto the island beaches, but large swells may act to erode the beach and thus resuspend accumulated debris before surveys. Winds may also blow lightweight debris off the beach or bury items under drifting sand.

OPERATIONAL SUPPORT

Volunteers contributed 40% of the total field time necessary to collect and record debris at CHIS in year 3. Volunteers included Fish and Game Biologists helping with intertidal surveys. Staff from several divisions participated in the surveys. Participants on a sea kayak camping trip participated on one survey.

Marine debris surveys were combined with rocky intertidal monitoring surveys at Santa Rosa Island in November and March and at San Miguel Island in December and April. This saved money for transportation and made the most efficient use of time.

In addition to funds from the National Park Marine Debris Monitoring Program, approximately $4,100 from park base operating accounts for permanent and seasonal staff time supported the surveys in year 4.

Several evening interpretive talks were given at the park during the year. The Park participated in the annual Coastal Cleanup by coordinating cleanup of the mainland beaches in front of the visitor center. The Park also supported a volunteer effort by sea kayak groups to cleanup beaches around Anacapa Island.

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FIGURES

Figure 4. Ten most abundant plastic items in Year 4, expressed as mean number per km.

Figure 5. Ten most abundant plastic items in Year 4 by season, expressed as mean number per km.